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ABSTRACT

The purpose of this research project was to determine if online learning could be adapted to individual learning styles and if this made a difference in the standardized testing scores of Internet students. An overview is provided of current learning theories, including the four stages of learning (exposure, guided learning, independent, mastery) and learning styles. Accepted online curriculum design is described, including: (1) course format; (2) four elements of online learning (instructor/teacher, student, curriculum, and infrastructure/technology); (3) characteristics of technology; (4) strengths and weaknesses of online learning; (5) learning activities that different learners respond well or poorly to; (6) adapting curriculum to learning styles; (7) constructivist learning environment, applying the constructivist model to the online classroom; (8) applying Kolb's experiential learning model to the online classroom; (9) considerations in instructional planning; (10) considerations in the construction of the learning environment; (11) considerations in selection of teaching methods; (12) and considerations in evaluation administration. Components of the ideal online course are summarized. Statistics on standardized test scores of online high school students are appended. (MES)

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Adapting Online Education to Different Learning Styles

By: Diana J. Muir

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Adapting Online Education to Different Learning Styles

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Abstract

The purpose of this research project was to determine if online learning could be adapted to individual learning styles and if that made a difference in the standardized testing scores of Internet students. We then compared those scores to those of traditional students. It has clearly been shown that online learning is adaptive, whereas traditional classrooms are not always adaptable. Our goal was to establish whether online learning and adaptive learning styles made a difference in test scores, and if so, could that knowledge be utilized in the traditional classroom? The answer was yes to both questions.

Current Learning Theories

There is a wealth of information, both on the shelves of libraries on the Internet, which addresses the different learning theories that have been suggested over the past 3 or 4 decades. Those most often quoted are Kolb and Gardner.

While most theorists disagree, or come from a different approach, about learning styles, it is generally accepted that there are basically four stages of learning. They are:

1. *Exposure Stage*—the first time a concept (such as long division) is new to us.
2. *Guided Learning Stage*—when we still can't do the problems without help. This is where most people get stuck.
3. *Independent Stage*—With review, guidance and hard work we reach stage 3.
4. *Mastery Stage*—Comes with more practice, final goal of education

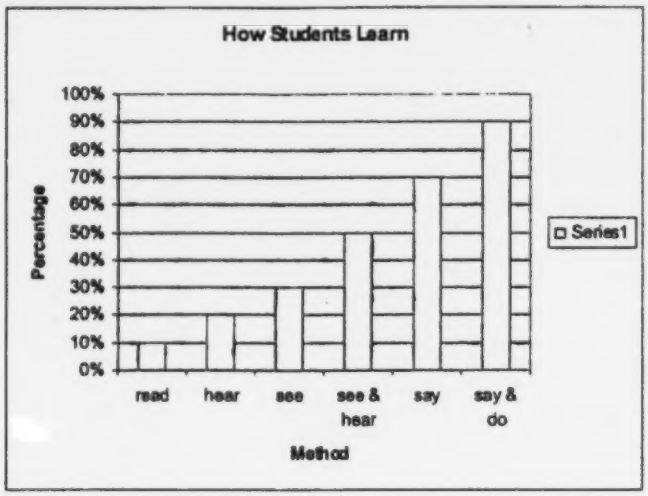
Regardless of how a student learns, the stages remain the same. It is up to the instructor and the curriculum content developer to assist the student in getting past the guided learning stage to become an independent learner, thus building on newly gained learning concepts or skills.

It has also been shown through repeated studies that students learn in different ways, or through a combination of different ways, thus supporting Smith and Kolb's learning cycle concept.

Students learn:

- 10% of what they read
- 20% of what they hear
- 30% of what they see

- 50% of what the see & hear
- 70% of what they say
- 90% of what they say and do



Based on what we have learned, we conclude that students need:

- A variety of teaching strategies
- A variety of learning paths
- Activities which they can read, visualize, hear, say and do
- Instructional guidance leading to independence
- Ability to work on their own with appropriate assessment methods
- Appropriate tools and technology for independent and guided study

Review of Learning Styles

As we have already discussed there is a wealth of information about different learning styles and theories. While many of these theories are methodologies instead of styles it is difficult to relate one to the other, at times. Therefore, we have presented a chart, which shows the relationships a little more clearly, thus appealing to the visual learner!

	Instruction	Testing	Assignments	Reference	Communication
Visual	use of a video clip, diagram, image or map	identification on maps, diagrams, required drawings or sketches, read and response	mind mapping of concepts (webbing) diagramming, construction of PowerPoint Presentations, readings	reference maps, diagrams, pictures, articles	use of electronic white board, electronic conferencing, chat
Auditory	lecture, audio clips	sound identification or verbally administered test	projects with audio components, interviews, seminars, giving of reports and speeches, power point w/ audio component	video or audio clips from a media collection	phone, audio conferencing
Tactile	advance organizer, in class exercises, asking for volunteer participation in class demos or simulations	performance of a task, multiple choice tutorial, reports/papers, portfolio of project work	self assessment quizzes, model building, presentations, demos	virtual field trips	synchronous conferencing, group work
Active	class participation	projects, reports	model building	virtual field trips	meetings
Passive	classtime for reflection or critical thinking	problem solving, essays	problem sets, journaling	observation, reading	webcast
Sequential	outlines, lists, examples	creation or reenactment of steps, processes	creation of steps, processes	reference materials of a procedural nature, scholarly journals	small discussion groups
Global	discussion of concepts, paradigms, theories	essay questions, portfolios	journaling, discussion, relationship construction, mapping	broad based reference materials, news paper articles, magazines and books	large discussion groups

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Sensory	images, sounds, video, demos, simulations	tests that ask for details, tests with accompanying images, audio	creations of demos, images, case studies	virtual field trips	any conferencing tool
Intuitive	case studies, hypothesis, setting and prediction	essays that ask for outcome projections	problem solving, resolution development	readings from various view points, compare and contrast assignments	any type of group work
Inductive	facts, formulas, demos and observations, presentation of background information	problem sets, objective answers, multiple choice	problem sets, memorization, terminologies	sample problems, reference sheets for formulas	any type of group work
Deductive	applications, link of the familar to the unfamiliar, examples, advance organizers	problem solving applications, scenarios, essays	model building, simulations	case studies	group projects or conferencing

Another part of employing learning strategies and theories is to incorporate Bloom's Taxonomy. Following the 1948 Convention of the American Psychological Association, Benjamin Bloom took the lead in formulating a classification of "the goals of the educational process". Three "domains" of educational activities were identified. The first of these, named the *Cognitive Domain*, involves knowledge and the development of intellectual attitudes and skills. The other domains are the *Affective Domain* and the *Psychomotor Domain*, which we are not concerned with.

Bloom and his co-workers eventually established a hierarchy of educational objectives, which is generally referred to as Bloom's Taxonomy. This taxonomy attempts to divide cognitive objectives into subdivisions ranging from the simplest behavior to the most complex. It is important to realize that the divisions outlined are not absolutes and that other systems or hierarchies have been devised. However, Bloom's taxonomy is the easiest to understand and is widely applied.

When writing curriculum for the online classroom, or even teaching in a traditional environment, it is as important as knowing how a teacher teaches, as well as how a student learns. Only by balancing the two of them can educational goals be realized.

There are several good examples of learning style inventories on the Internet that focus on a variety of learning styles. They are:

1. http://www.uncwil.edu/sasp/online_tutor/learnst.html (Tactile/Kinesthetic, Visual, Auditory)
2. http://www.edu.psc-cfp.gc.ca/tdc/continu/english/invento.htm (Enthusiastic, imaginative, practical or logical)
3. http://diogenes.baylor.edu/Library/LIRT/inventory.html (Visual, Auditory, Tactile)
4. http://alaike.lcc.hawaii.edu/lrc/lstest.html (Visual, Auditory, Kinesthetic)
5. http://www.active-learning-site.com/inventory1.html Vart Inventory (Visual, Aural, Read, Kinesthetic)

6. http://www.mxctc.commnet.edu/clc/survey.htm (Visual, Auditory, Kinesthetic/Tactile

Accepted Online Curriculum Design

Course Format

Until recently online education has been a hodge-podge of techniques in presenting curriculum content and creating an interactive environment. Most of this has been because instructors are attempted to use traditional methods of teaching in the classroom to teach on the Internet. The web based educational environment does well in presenting material in a visual manner. However, as we know, not all learners are visual learners. In order to apply Kolb's learning cycle concept, different methodologies need to be integrated into the learning environment.

Current online curriculum design includes:

- Syllabus
- Course Outline
- Readings or Lectures
- Classroom or Threaded Discussion
- Quizzes/Tests/Assessments
- Feedback and Interaction between student and instructor/facilitator through email

While these elements typically represent a traditional classroom and should certainly be included, courses also need to develop learning activities which address different learning styles and to incorporate teaching and learning strategies into 'each' element so that all learning styles are addressed.

Most of the online curriculum today is presented by universities and colleges who are moving into the online environment. Few K-12 schools, although making use of the many resources on the Internet, actually deliver full-content lessons or courses—via the Internet—to distance learning students.

Because traditional online learning is geared towards the adult learner, it can be assumed that students are aiming for a specific goal (a degree, certificate or grade) and thus adapt their own learning styles to the material delivered. Focus on different learning styles is largely ignored in an attempt to address the largest number of students in order to get a generally acceptable results (a degree, certificate or acceptable grade).

The goal of K-12 education, on the other hand, should be not only to teach basic concepts and material, but also to teach students to maximize their learning style, improve upon other learning styles and develop into a life-long learner who can make the best use of material presented at a later stage in life. In order to do this, K-12 educators have tried for years to incorporate teaching strategies and learning styles in coursework and activities through the use of manipulatives, handouts, visualization aids, videos, films, field trips, etc. When reaching the post-secondary level, many of these teaching concepts go by the wayside in order to accommodate delivering large amount of contents to large amounts of students.

The goal becomes: taking traditional learning style teaching methods employed in the traditional K-12 classroom and applying it to online learning which can then be individualized, not only for the K-12 student, but for adult learners as well.

Four Elements of Online Learning

There are basically four elements of online learning. They are:

1. Instructor/teacher

2. Student

3. Curriculum

4. Infrastructure or Technology

As mentioned before it is important to know not only how the teacher is used to teaching (so that teaching strategies can be employed and methodologies adapted), student learning styles identified so that they may be addressed, and curriculum formatted in an appropriate delivery style to address all learning and teaching styles, but the infrastructure or technology must support the delivery of the content.

Characteristics of Technology

Technology, typically, is able to do the following:

1. control the mode of delivery and presentation rate.

2. control the order of presentation, pace of instruction and selection of learning activities.

3. monitor learning performance, store responses, and conduct assessments.

4. provide simulations that supply learning experiences in a variety of low-cost and risk-free topics.

5. formulate collaborative learning groups by linking the learner to the instructor and to other students for technical and curricular support.

6. allow access to learning resources and assessment materials via the Internet.

There are currently 10 standard functions of technology in distance education. This is not to say that this is the way that technology 'should' be used, only that this is the way is which it is 'traditionally' employed. Technology is traditionally employed as:

1. the notice board.

2. the public tutorial.

3. the individual project.

4. free flow discussion.

5. the structured seminar.

6. peer counseling.

7. a collective database.

8. group products or projects.

9. community decision-making.

10. inter-community network.

While these functions allow all the elements of the course content to be delivered (syllabus through assessment), the method of delivery and amount of interactivity determines how much of the content and delivery is actually learned and comprehended. Without applying learning styles to the methods in which

these technology functions are carried out, technology is not being used to its fullest extend and learners are not receiving the full benefit of online education.

Strengths and Weaknesses of Online Learning

Due to the way in which traditional content has been applied and delivered via the Internet, certain advantages and disadvantages of online learning have become apparent. Advantages include:

- Learning can take place anywhere
- Learning can take place anytime and at any pace.
- There is a synergy between the learner, instructor and environment.
- High quality dialogue can be maintained because it is not restricted by a traditional classroom or time models.
- The environment can be student centered, in that instructors can focus on an individuals learning styles and issues with greater ease.
- There is great access to a larger variety of quality resources.
- There is a level playing field for all learners, regardless of visual or physical handicap, location or learning schedule.
- Teachers can use creative teaching methods in delivering material.

The disadvantages include:

- Equity and accessibility to technology in that not all students can afford top-of-the-line computers with multi-media accessibility.
- Computer literacy—students have different degrees of familiarity with the computer, Internet and software programs. This can adversely impact their ability to participate to the fullest.
- Limitations of technology—there are some things a computer simply cannot do such as real-life simulations, chemical laboratory experiments, and medical dissections. Visualizations are useful, but not as good as actually 'being there.'
- Lack of essential online qualities—without the necessary direction, teaching strategies and integration of student learning strategies, learning styles cannot be fully utilized and learning is limited.
- Levels of synergy—face-to-face or voice-to-voice contact is still useful to establish synergy, trust and mentor effectiveness.
- Some courses (activity, hands-on subjects) can't be taught online—some topics such as music, physical fitness and art are very difficult to teach online.

Learning Activities Which Different Learners Respond Well and Poorly To:

In order to fully take advantage of online learning, an instructor needs to understand what types of activities learners respond to so that they can apply the same techniques in their course delivery. Some of these which they respond well to and poorly are:

Respond well:

- *Activists*—respond well to new problems, being thrown in at the deep end, and team work.
- *Theorists*—interesting concepts, structured situations, and opportunities to question and probe.
- *Pragmatists*—relevance to real problems, immediate chance to try things out, and experts they can emulate.
- *Reflectors*—thinking things through, painstaking research, detached observation

Respond poorly to:

- *Activists* respond poorly to passive learning, solitary work, theory, and precise instructions. They would rather take an active part in learning.
- *Theorists*—the lack of apparent context or purpose, ambiguity and uncertainty, doubts about validity creates a lack of basis for learning.
- *Pragmatists*—Abstract theory, lack of practice or clear guidelines, no obvious benefit from learning do not allow pragmatists to apply learning to real-life situations.
- *Reflectors* —Being forced into the limelight, acting without planning, time pressures creates a tense learning environment.

Adapting Curriculum to Learning Styles

Different Approaches to Distance Learning (Online Education)

Up to recently, there have been two basic approaches to online learning. They are:

1. taking structured, pre-programmed learning materials and creating a "black box" approach where the black box is substitute for the teacher and 'teaches' the student.

2. using the computer's communications functions and creating a "networks" approach which views the computer as a channel of communication between learners and teachers. Teachers teach students and the computers facilitate communications between teachers and students.

While both of these methods may be useful in different circumstances, unless they integrate different approaches to address -different learning styles and create a learning cycle, they are still basically ineffective.

Constructivist Learning Environment

Lately, the most widely talked about theory has been the Constructivist theory that advocates that the learning process should:

1. provide experience with the knowledge construction process (provide students with the knowledge construction process).

2. provide experience in and appreciation for multiple perspectives (multiple ways to think about and solve problems).

3. embed learning in realistic and relevant context (maintain the authentic context of the learning task).

4. encourage ownership and voice in the learning process (student center learning).

5. embed learning in social experience.

6. encourage the use of multiple modes of representation (Use multiple of presentation).

7. encourage self-awareness of the knowledge construction process. (Encourage metacognitive and activities)

Applying the Constructivist Model to the Online Classroom

While the constructivist theory might be an excellent way of looking the needs of the learning process, it does 'not' imply a way to translate those goals into the classroom, and especially into the virtual classroom. That is what we will attempt to do, as well as integrate Kolb's Experiential Learning Model to the online classroom.

The Constructivist Model has four basic principles:

1. Learning is an active and engaged process. Learners should be actively involved in activities that are authentic to the environment in which they would be used.

2. Learning is a process of constructing knowledge.

3. Learners function at a metacognitive level, focusing on thinking skills rather than working on the "right answer." Students should generate their own strategies for defining problems and working out solutions. Students gain wisdom through reflection.

4. Learning involves "social negotiation." Students should be able to challenge their thoughts, beliefs, perceptions and existing knowledge by collaboration with others and assisting their cognitive development process.

There are also some basic assumptions of design in the constructivist model, although theorists have not told us how to apply these to the classroom. They are:

1. All knowledge is constructed and all learning is a process of construction.

2. Many worldviews can be constructed; hence there will be multiple perceptions.

3. Knowledge is context dependent, so learning should occur in contexts to which it is relevant.

4. Learning is mediated (and delivered) by tools and signs.

5. Learning is an inherently social-dialogical activity.

6. Learners are distributed, multi-dimensional participants in a socio-cultural process.

7. Knowing 'how' we know is the ultimate human accomplishment.

The first step to applying the constructivist model to the online classroom is to construct the environment. You can do this by:

1. Take basic information derived from a learning needs assessment and convert it into:

   - learning outcomes.
   - information included in the materials.
   - how material is structured.
   - what the target audience understands about the material.
   - how the material might be structured for the target audience.

2. Review the basic description and link the elements to an appropriate instruction or presentation strategy. I:

   - Identify metaphors.

- The outcome would be a formal description such as a design brief to enable the reader to understand the underlying knowledge structures and the way it is proposed to link them conceptually and intuitively.

3. Review material again with the goal of linking the design ideas into a potential interaction structure.

   - Create an interactive mock-up of interactive materials using an authoring tool.

Applying Kolb's Experiential Learning Model to the online classroom:

1. Four processes must be present for learning to occur:

   - Concrete experience—laboratories, field work, observations, trigger films,
   - Reflective observation—logs, journals, brainstorming.
   - Abstract conceptualization—lecture, papers analogies.
   - Active experimentation—simulations, case study, homework.

2. Learning is more than just environment:

   - It includes active participation in the learning process and "perception of the learning event through concrete experience (sensing and feeling) or abstract conceptualization (thinking and analyzing).

There are also some things that you need to consider in instructional planning:

1. The Learner as a User

   - Consider Learning Styles
   - The range and extent of user interaction

2. Design Constraints

   - Information and Visual Design
   - Access—Navigation
   - Interactivity and Control
   - Motivation

3. Audience analysis—Use appropriate cognitive style instruments to measure and identify the student's cognitive styles

   - Kolb's inventory—too laden with jargon and hard to answer
   - Myers-Briggs focus on personality rather learning style diminished effectiveness
   - Soloman's 28 questions were easy to answer

4. Terminal objectives

   - Should focus on students' preferred cognitive styles as well as the nonpreferred cognitive styles.

5. Instructional preparation

   - Instructor should match cognitive styles and instructional contents, methods and styles.

Things to consider in the construction of the learning environment:

6. Online contact

   - Construct a supportive environment and provide timely online contact and assistance to all students
     - Online peer contact
     - Online contact between teacher and students

7. Diversified Learning Styles

   - Theory based learning to 'assimilators'
   - Application-based learning to 'accommodators'
   - Individualized learning to 'field independent' students
   - Cooperative learning to 'field dependent' students.

Things to consider in selection of teaching methods:

8. Match the instructional material with cognitive styles

   - Match the type of content with verbal-visual styles
     - Verbal versions of pictorial and diagrammatic material to verbalizers
     - Verbal material to convert to pictorial form and supplied with concrete analogies of abstract ideas to the visualizers

9. Matching the teaching styles with cognitive styles

   - Match the instructional strategy with field dependence-independence style—both cooperative and individualized learning
   - Match the layout of materials with holist-analytic styles—provide holist view and diagrammatic materials such as tables and tree diagrams
   - Match the conceptual structure with holist-analytic style—identify the parts and structure of the material provide a picture of the whole thing
   - Match the choice of presentation mode with sensory preference—written material to verbalizers, pictorial presentation to visualizers and include multiple modes of presentation such as visual, verbal and auditory imagery.
   - Match social preferences with verbal-imagery style—provide lively, outgoing and stimulating presentations to verbalizers and less bothered tasks about a dynamic presentation to imagers.
   - Match teaching aids with hemispheric preference—a combination of various instructional design, teaching techniques, and modes of presentation, such as computer based multimedia presentation, drawings, transparencies, videotapes, lectures and discussions.

When Considering Evaluation Administration:

1. Assessment—should cover the entire course or lesson

   - Contents of the Assessment
     - Knowledge
     - Comprehension
     - Application
     - Analysis
     - Synthesis
     - Evaluation

- Different Assessment Tools
  - Regular assignments
  - Individual or group projects
  - Online or in-class quizzes
  - Take-home exams
- Content of the Assessment Tools
  - Fill in the blank
  - Multiple-choice questions
  - Identification of terms
  - Variety of short answer and essay questions
  - Writing assignments
- In Addition
  - Teachers shou!d provide appropriate hints or
  - Diagrams, tables, and verbal description for different assessment instruments

2. Feedback

- Timely feedback
- Primarily positive and encouraging

The "Ideal" Online Course

In conclusion, if an institution or instructor has incorporated adaptive teaching methodologies and made the best use of the curriculum and technology, an "ideal" online course would include the following:

1. ***Full Content Courses***—It should cover the same content that a traditional course would include and should either be text-based, or cover the same content as nationally accepted textbooks such as Prentice Hall, Holt Rinehart and Winston.

2. ***Student Learning Objectives which use Bloom's Taxonomy***—Each lesson plan should include student learning objectives which cover the goals and objectives of that particular lesson. They should include Bloom's Taxonomy words at all 6 levels in order to encourage and build upon the learning cycle. They should also include objectives which focus on all the different learning styles; visual, auditory and kinesthetic/tactile.

3. ***Teacher Strategies which address all learning styles***—Teacher strategies should be included with each lesson so that teachers have the opportunity and ability to adapt their teaching styles to individual learners without having to resort to continuous re-education.

4. ***Activities that adapt to different learning styles***—Web based interactive activities should be included which address a variety of learning styles. These activities should enhance the lesson content and offer opportunity to further exploration in the content area.

5. ***Assessments that cover full content***—Assessments that can be computer graded if possible (short answer and essay are rarely graded unless parsing is included in the technology infrastructure) should be included to cover the entire scope of the lesson. They should also be in a variety of forms (identify and define, true/false, multiple choice, multiple answer, short answer, essay) so that individual learning styles are challenged and so that students are encouraged to build a 'learning cycle.' They should also employ all 6 levels of Bloom's taxonomy so that student's are challenged to think on different levels.

7. ***Accreditation by a local or state agency***—Online courses should be offered by an accredited institution that has undergone a peer review process.

8. ***Curriculum that can adapt to other state curriculum guidelines***—Course curriculum should be adaptable so that it can include additional learning objectives or activities in order to adapt to differing state curriculum guidelines, if necessary.

9. ***Use of technology to its fullest***—Courses should use technology to its fullest for both asynchronous and synchronous learning, email, and multi-media presentations.

10. ***Be available online 24/7***—Course content should be available at all times online for student review and access. Students and instructors should also have access to curriculum and technical support, within reason.

Addendum Research Statistics

(All statistics are the result of a 3-year study done by E-School! International of Iowa City, Iowa involving a total of 158 students in a 9-12th grade, accredited online curriculum. This was done in conjunction with the Belin & Blank Center for Gifted Education, at the University of Iowa and Intelligent Education, Inc. of Atlanta, Georgia. Standardized test results are taken from the Center for Education Statistics, online database.)

Typical distribution of SAT scores for incoming freshman classes		
700-800	6	2
600-699	29	34
500-599	47	40
400-499	18	24
300-399	0	0
200-299	0	0

Distribution of ACT Scores			
30-36	7	10	12
24-29	48	44	41
28-23	44	40	39
12-17	1	6	8
6-11	0	0	0
0-10	0	0	0

SAT-Verbal			
	1986-87	1996-97	1997-98
All students	507	505	505
Online Students			538
Homeschoolers	510	512	515
White	524	526	526
Black	428	434	434
Hispanic or Latino	464	466	461
Mexican American	457	451	453
Puerto Rican	436	454	452
Asian American	479	496	498
American Indian	471	478	480
Other	480	512	511

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SAT-Mathematical			
	1986-87	1996-97	1997-98
All students	501	511	512
Online Students			538
Homeschoolers	522	530	535
White	514	526	528
Black	411	423	426
Hispanic or Latino	462	468	466
Mexican American	455	458	460
Puerto Rican	432	447	447
Asian American	541	560	562
American Indian	463	475	483
Other	482	514	514

Average mathematics and science achievement scores of high school seniors						
	Mathematics			Science		
	Overall	Male	Female	Overall	Male	Female
International average	500	518	485	500	521	482
Online Students	565	588	545	560	562	558
Homeschoolers	560	590	540	555	579	530
Netherlands	560	585	533	558	582	532
Sweden	562	573	531	559	585	534
Denmark	547	575	523	509	532	490
Switzerland	540	555	522	523	540	500
Iceland	534	558	514	549	572	531
Norway	528	555	501	544	574	513
France	523	544	506	487	508	468
Australia	522	540	510	527	547	413
New Zealand	522	536	507	529	543	515
Canada	519	537	504	532	550	518
Austria	518	545	503	520	554	501
Slovenia	512	535	490	517	541	494
Germany	495	509	480	497	518	478
Hungary	483	485	481	471	484	455
Italy	476	490	464	475	495	458
Russian Federation	471	488	460	481	510	463
Lithuania	469	485	461	461	481	450
Czech Republic	466	488	443	487	512	450
United States	461	486	456	480	492	469
Cyprus	446	454	439	448	459	439
South Africa	356	365	348	349	367	333

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